U.S. Department
of Transportation
**Federal Aviation
Administration**

U.S. DEPARTMENT of TRANSPORTATION

Federal Aviation Administration

Interface Requirements Document
(DRAFT)

National Airspace System (NAS) Voice System (NVS) to
Federal Aviation Administration (FAA) Telecommunication Infrastructure (FTI)

INTERFACE REQUIREMENTS DOCUMENTS
APPROVAL SIGNATURE PAGE

National Airspace System (NAS) Voice System (NVS)
To Federal Telecommunication Infrastructure (FTI)

APPROVAL SIGNATURES		
PARTICIPANT	NAME	DATE
[Organization]	[Person]	[Date]

REVISION RECORD

REVISION LETTER	DESCRIPTION	DATE	ENTERED BY

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1. SCOPE

1.1 Summary

This Interface Requirements Document (IRD) is prepared in accordance with documents FAA-STD-067 and FAA-STD-025.

This IRD provides the requirements for the interfaces between the Federal Aviation Administration's (FAA) National Airspace System (NAS) Voice System (NVS) and the FAA Telecommunications Infrastructure (FTI). Services for transporting voice, data and video information to fulfill the FAA's operational mission of controlling air traffic are currently acquired via the FTI contract. FTI services for transporting voice and data will be used in the NVS. The NVS interfaces to the FTI that are described in this document will support Networked Air to Ground (A/G), Networked Ground to Ground (G/G) and NVS Management System (NVSMS) communications.

The design characteristics of the NVS to FTI interfaces will be captured by the vendor in an Interface Control Document (ICD).

Section 2 lists the reference documents used in developing this IRD.

Section 3 defines the interfaces in terms of their general, functional, and physical characteristics.

Section 4 defines the Quality Assurance provisions for this IRD.

Section 5, Preparation for delivery, is not applicable in this IRD.

Section 6, Notes, contains definitions, abbreviations and acronyms used in this IRD.

1.2 Subsystem Responsibility List.

Table 1-1 Subsystem equipment responsibility

Subsystem/Equipment	Common Name	Responsible Organization
NVS	NAS Voice System	AJW-54
FTI	FAA Telecommunications Infrastructure	AJW-53

2. APPLICABLE DOCUMENTS

The following documents form a part of this IRD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this IRD, the contents of this IRD shall be the superseding requirements.

2.1 Government Documents

2.1.1 Federal Aviation Administration

2.1.1.1 Standards

FAA-STD-019e	Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment, December 22, 2005
FAA-STD-025f	Preparation of Interface Documentation, November 30, 2007
FAA-STD-039c	National Airspace System (NAS) Open System Architecture and Protocols August 14, 2003
FAA-STD-042b	National Airspace System (NAS) Naming And Addressing Structure For Ground-To-Ground Communication March 11, 2005
FAA-STD-045a	National Airspace System (NAS) Communications Security Protocols and Mechanisms March 11, 2005
FAA-STD-061	Airport Fiber Optic Transmission Systems October 15, 2003
FAA-STD-067	Preparation of Specifications December 4, 2009
NAS 1370-500.4	FAA Enterprise Network Internet Protocol Version 4 (Ipv4) NAS Intranet Address Assignments May 20, 2003

2.1.1.2 Handbooks

None

2.1.1.3 Specifications

FAA-E-NVS   Federal Aviation Administration Procurement Specification, National Airspace System (NAS) Voice System (NVS)
Draft

DTF01-02-D-03006   FTI Telecommunications Services Description (FTSD), Modification P0040, Attachment J.1

FAA-G-2100H   Federal Aviation Administration Specification, Electronic Equipment, General Requirements,
9 May 2005

2.1.1.4 FAA Orders

None

2.1.1.5 Other FAA Documents

None

2.1.2 Military Documents

None

2.2 Non-Government Documents

2.2.1 Standards

None

2.2.2 Specifications

IEEE 802.2   Logical Link Control
May 1998

IEEE 802.3   Local Area Networks: Carrier sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specification.
1998

IEEE 802.5   Local Area Networks: Token Ring Access Method and Physical Layer Specifications
January 1, 1989

TIA/EIA-568-C   Commercial building cabling for telecom products and
                       services
                       February 2009

2.2.3 RFC

RFC 791   Internet Protocol
                      September 1981

RFC 792   Internet Control Message Protocol
                      September 1981

RFC 796   Address Mappings
                      September 1981

RFC 826   Ethernet Address Resolution Protocol: Or Converting
                      Network Protocol Addresses to 48.bit Ethernet Address for
                      Transmission on Ethernet Hardware
                      November 1982

RFC 894   A Standard for the Transmission of IP Datagrams over
                      Ethernet Networks
                      April 1984

RFC 950   Internet Standard Subnetting Procedure
                      August 1985

RFC 1042   A Standard for the Transmission of IP Datagrams over
                      IEEE 802 Networks
                      February 1988

RFC 1518   An Architecture for IP Address Allocation with CIDR
                      September 1993

RFC 1519   Classless Inter-Domain Routing (CIDR): an Address
                      Assignment and Aggregation Strategy
                      September 1993

RFC 1918   Address Allocation for Private Internets
                      February 1996

RFC 2050   Internet Registry IP Allocation Guidelines
                      November 1996

RFC 2460	Internet Protocol, Version 6 (IPv6) Specification December 1998
RFC 2464	Transmission of IPv6 Packets over Ethernet Networks December 1998
RFC 2474	Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers December 1998
RFC 3168	The Addition of Explicit Congestion Notification (ECN) to IP September 2001
RFC 3260	New Terminology and Clarifications for Diffserv April 2002
RFC 3376	Internet Group Management Protocol, Version 3 October 2002
RFC 4291	IP Version 6 Addressing Architecture February 2006
RFC 4443	Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification March 2006
RFC 4604	Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast August 2006

2.3 Document sources.

2.3.1 Source of FAA Documents

Copies of FAA specifications, standards, and publications may be obtained from the contracting officer, Federal Aviation Administration, 800 Independence Ave., S.W., Washington, DC 20591.

2.3.2 <u>Source of TIA/EIA Documents</u>

Copies of TIA/EIA specifications, standards, and publications may be obtained from the Standards and Technology Department of the Telecommunication Industry Association, 2500 Wilson Boulevard, Arlington, Virginia 22201.

2.3.3 <u>Source of IETF Documents</u>

Copies of IETF RFCs may be obtained from the IETF Website at http://www.ietf.org/rfc.html.

2.3.4 <u>Source of IEEE Documents</u>

Copies of Institute of Electrical and Electronics Engineers (IEEE) documents may be requested as follows: by mail at IEEE Customer Service, 445 Hoes Lane, Piscataway, NJ 08854-4141; by phone (800) 701-4333 (in the United States and Canada) or (732) 981-0060 (outside the United States and Canada); or via the following Website: http://www.ieee.org/web/standards/home/index.html.

3. INTERFACE REQUIREMENTS

3.1 General Requirements

This IRD describes the interface requirements between the NVS and the FTI, herein referred to as the "NVS to FTI interface". The FTI provides services and features to satisfy the telecommunications services required by the FAA.

The NVS will utilize FTI Operational IP service class(es) TBD. A comprehensive description of service class attributes is contained in the FAA Telecommunications Services Description (FTSD).

Figure 3-1 depicts how the FTI service interface and the FTI telecommunications service combine to provide the NVS with services and features from Service Delivery Point (SDP) to SDP.
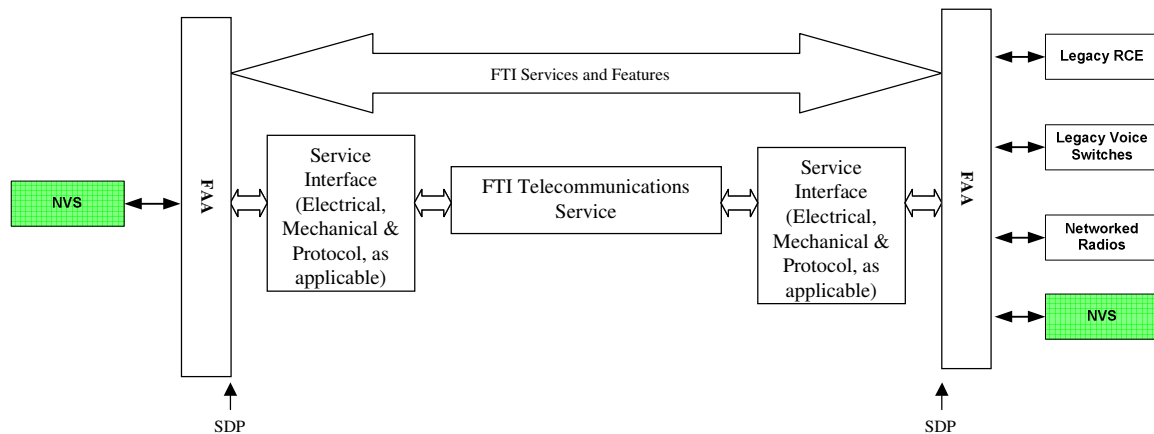
Figure 3-1 FTI Providing the NVS Services and Features

The SDP is defined as the demarcation point between the NVS and the FTI. The SDP for the NVS to FTI interface will consist of the connection between the NVS Media Gateway and Network Interface and the FTI Edge Device. Figure 3-2 depicts the SDP for the NVS to FTI interface.
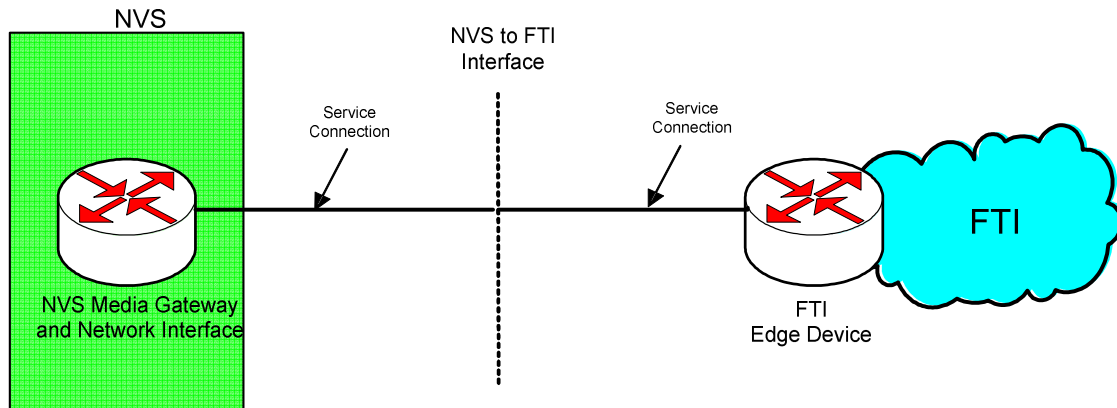
Figure 3-2 SDP for the NVS to FTI Interface

3.1.1 NVS Interfaces to the FTI

Figure 3-3 depicts utilization of the NVS interfaces to the FTI to support Networked A/G, Networked G/G and NVSMS communications.
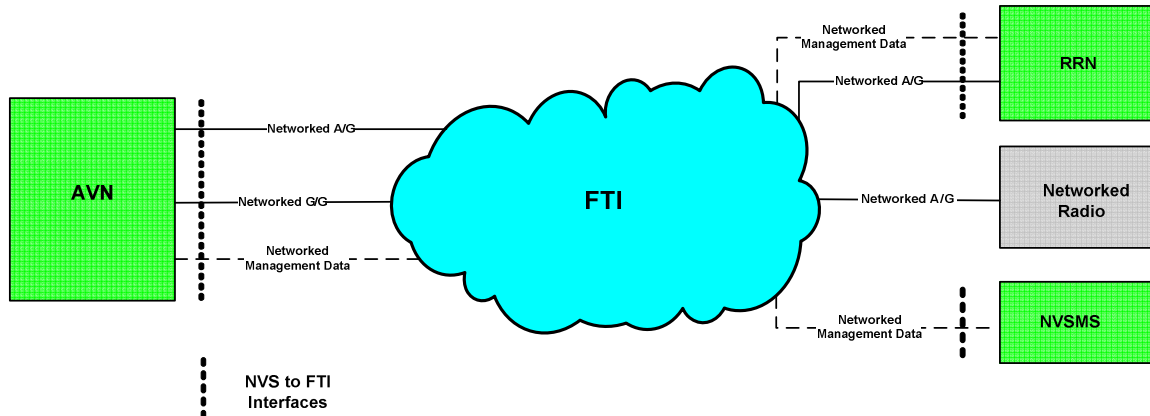
Figure 3-3 NVS AVN to FTI Functional Interface

a. The NVS **must** interface with the FTI to support Networked A/G communications.

b. The NVS **must** interface with the FTI to support Networked G/G communications.

c. The NVS **must** interface with the FTI to support NVSMS communications.

3.1.2 Security Requirements

The FAA security policy ensures that all NAS information systems are protected from threats to integrity, availability, and confidentiality. The NVS will conform to this policy by utilizing the standardized FAA security architectures, security protocols, and security mechanisms as described in FAA-STD-045a. There are no specific security requirements in this IRD.

3.2 Functional Requirements

3.2.1 Analog-type Interface Requirements

Not applicable in this IRD.

3.2.2 Discrete-Type Interface Requirements

Not applicable in this IRD.

3.2.3 OSI-Type Interface Requirements

This section defines the interface requirements for the NVS to FTI interface related to the Open Services Interconnection (OSI) reference model. The FTI provides the Network layer, the Data Link layer and the Physical layer (layers 1 to 3) of the OSI reference model. The upper layers (layers 4 to 7) of the OSI reference model are part of the application interface between two communicating NAS entities and are not processed by the FTI. These upper layer protocols are carried as transparent data in the payload portion of IP Protocol Data Units (PDU) processed by the FTI network layer. Table 3-1 depicts the OSI reference model layers provided by the FTI.

Table 3-1 OSI reference model layers provided by FTI

OSI MODEL			
	DATA UNITS	**LAYER**	**FUNCTION**
HOST LAYERS - Application interface between two communicating NAS enities	Data	7 - Application	Network process to application
		6 - Presentation	Data representation and encryption
		5 - Session	Interhost communication
	Segment	4 - Transport	End-to-end connections and reliability
MEDIA LAYERS - **Provided by FTI**	Packet	3 - Network	Path determination and logical addressing
	Frame	2 - Data Link	Physical addressing
	Bit	1 - Physical	Media, signal and binary transmission

Figure 3-5 illustrates the NVS to FTI functional interface on the Network, Data Link and Physical OSI reference model layers. This figure also illustrates that the functional interface is provided at the SDP.
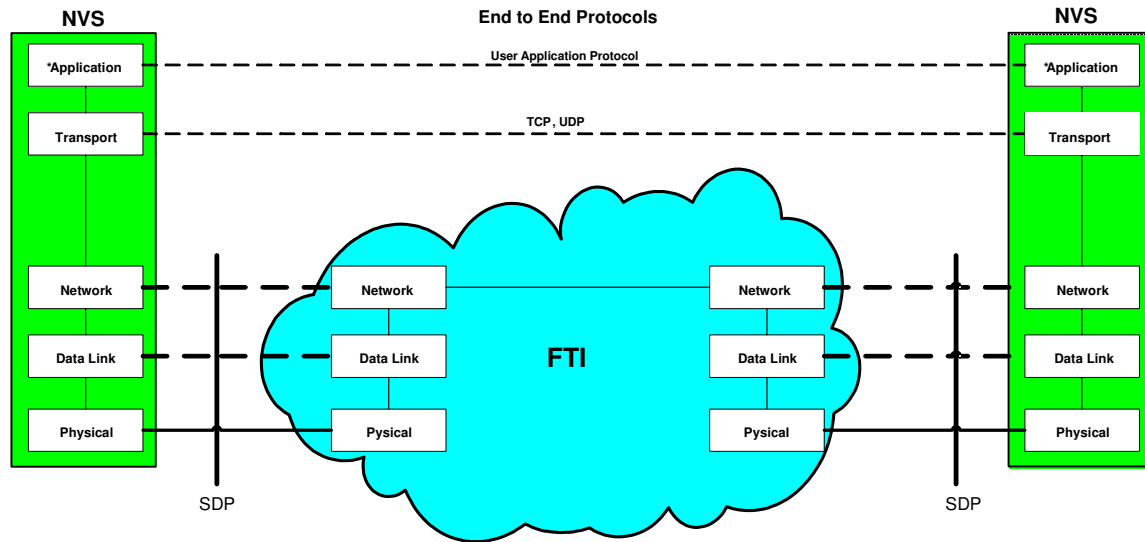
Figure 3-4 NVS to FTI Functional Interface

3.2.3.1 Application Layer

This layer is outside of the scope of this IRD.

3.2.3.2 Presentation Layer

This layer is outside of the scope of this IRD.

3.2.3.3 Session Layer

This layer is outside of the scope of this IRD.

3.2.3.4 Transport Layer

This layer is outside of the scope of this IRD.

3.2.3.5 Network Layer.

The NVS will utilize the FTI's Operational IP network layer services.   The FTI Operational IP network layer services primarily provide address resolution and IP packet transport.

    a. The NVS **must** support Network layer interfaces to the FTI as specified in FAA-STD-039c, section 5.3.

    b. The NVS **must** support Network layer addressing as specified in FAA-STD-042b, section 5.3 for the NVS to FTI interface.

3.2.3.5.1 IPv4

a. The NVS **must** support IPv4 protocol, as specified in RFC 791, for the NVS to FTI interface.

b. The NVS **must** support Internet Control Message Protocol (ICMP), as specified in RFC 792, for the NVS to FTI interface.

c. The NVS **must** support the capabilities specified in RFC-2474 for IPv4, for the NVS to FTI interface.

d. The NVS **must** support the capabilities specified in RFC-3168 for IPv4, for the NVS to FTI interface.

e. The NVS **must** support the capabilities specified in RFC-3260 for IPv4, for the NVS to FTI interface.

3.2.3.5.1.1 Addressing

a. The NVS **must** support addressing for IPv4 protocol, as specified in RFC 796, for the NVS to FTI interface.

b. The NVS **must** support address allocation for IPv4 protocol, as specified in RFC 2050, for the NVS to FTI interface.

c. The NVS **must** support address assignment for IPv4 protocol, as specified in RFC 1918 and the latest version of NAS1370-500.4., for the NVS to FTI interface.

d. The NVS **must** support address subnetting for IPv4 protocol, as specified in RFC 950, for the NVS to FTI interface.

e. The NVS **must** support Classless Interdomain Routing for IPv4 protocol, as specified in RFC 1518 and RFC 1519, for the NVS to FTI interface.

3.2.3.5.1.2 Routing

a. The NVS **must** support interior routing functionality for IPv4 protocol, as specified in FAA-STD-039c, section 5.3.2.1 for the NVS to FTI interface.

3.2.3.5.2 IPv6

a. The NVS should support IPv6 protocol, as specified in RFC 2460, for the NVS to FTI interface.

b. The NVS should support ICMP for IPv6, as specified in RFC 4443, for the NVS to FTI interface.

3.2.3.5.2.1 Addressing

a. The NVS should support addressing for IPv6 protocol, as specified in RFC 4291, for the NVS to FTI interface.

3.2.3.5.2.2 Routing

a. The NVS should support interior routing functionality for IPv6 protocol, as specified in FAA-STD-039c, section 5.3.2.1 for the NVS to FTI interface.

3.2.3.5.3 Internet Group Management Protocol

a. The NVS **must** support Internet Group Management Protocol (IGMP) as specified in RFC 3376 and RFC 4604 for the NVS to FTI interface.

3.2.3.6 Data Link Layer.

The NVS to FTI interface will utilize Ethernet as the Data Link layer protocol. The FTI data link layer services support the Media Access Control (MAC) sub-layer and Logical Link Control (LLC) sub-layer of Ethernet. While support of Ethernet is specified as a requirement in this section of the IRD, it does not preclude the use of other link protocols in the data link layer.

a. The NVS **must** support Ethernet implemented as the Data link layer as specified in FAA-STD-039c, section 5.2 for the NVS to FTI interface.

3.2.3.6.1 Media Access Control Sub-Layer

a. The NVS **must** support transmission of IP datagrams over IEEE 802.3 networks as specified in RFC 1042 for the NVS to FTI interface.

b. The NVS **must** support transmission of IPv4 datagrams over Ethernet networks as specified in RFC 894 for the NVS to FTI interface.

c. The NVS **must** support transmission of IPv6 datagrams over Ethernet networks as specified in RFC 2464 for the NVS to FTI interface.

3.2.3.6.2 Logical Link Control Sub-Layer

a. The NVS **must** support the Ethernet interface logical link control sub-layer as specified in IEEE Std 802.2, 1998 Edition(R2003) Part 2: Logical Link Control for the NVS to FTI interface.

3.2.3.6.3 Address Resolution Protocol

a. The NVS **must** support Address Resolution Protocol as specified in RFC 826 for the NVS to FTI interface.

3.2.3.7 Physical Layer

The Physical layer interface to FTI is typically implemented using full-duplex Ethernet. Multiple physical media connections between the NVS access device and the FTI edge device will be used to support the Reliability, Maintainability, Availability (RMA) requirements of the NVS service.

a. The NVS **must** support Ethernet as a Physical layer interface as specified in FAA-STD-039c, section 5.1 for the NVS to FTI interface.

b. The NVS **must** support implementation of 100BASE-FX Ethernet over fiber as specified in FAA-STD-061.

   NOTE: Please refer to FAA-STD-061 section 6.2.2 regarding citation of entire standard.

c. The NVS **must** support the Ethernet physical layer interface in accordance with IEEE 802.3-2008, Section 6 and Section 7 for the NVS to FTI interface.

d. The NVS **must** support 100BASE-T media in the physical layer in accordance with IEEE 802.3-2008, Clause 22 Reconciliation Sublayer (RS) and Media Independent Interface (MII) and Clause 28 Physical Layer link signaling for Auto-Negotiation on twisted pair for the NVS to FTI interface.

e. The NVS **must** support 100BASE-FX media in the physical layer in accordance with IEEE 802.3-2008, Clause 22 Reconciliation Sublayer (RS) and Media Independent Interface (MII) and Clause 26 Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX for the NVS to FTI interface.

f. The NVS **must** support Gigabit media in the physical layer in accordance with IEEE 802.3-2008 Section 35 Reconciliation Sublayer (RS) and Gigabit Media Independent Interface (GMII) for the NVS to FTI interface.

g. The NVS **must** support at least two physical media connections to the FTI edge device(s) to support high availability network service requirements for the NVS to FTI interface.

h. The NVS **must** support at least two IP connections to each A/G communication channel (each channel consists of up to two frequencies).

NOTE: Each physical media connection to the FTI will be standard availability interfaces utilizing avoidance.

3.3 Physical Requirements

3.3.1 Electrical Power/Electronic Requirements

The requirements specified in this section are described in accordance with FAA-G-2100.

3.3.1.1 Connectors

a. The NVS **must** terminate category 5e cable with connecting hardware as specified in TIA/EIA-568-C.1, sub-clause 10.2.3 for the NVS to FTI interface.

b. The NVS **must** terminate fiber cable with connecting hardware as specified in TIA/EIA-568-C.1, sub-clause 10.3.2 for the NVS to FTI interface.

c. The NVS **must** comply with the removable parts and mating connector requirements as specified in FAA-G-2100, paragraphs 3.1.2.1 for the physical interface to the FTI.

d. The NVS **must** comply with the electrical connector requirements as specified in FAA-G-2100, paragraphs 3.3.1.4.3 for the physical interface to the FTI.

e. The NVS **must** comply with the electrical connector safety requirements as specified in FAA-G-2100, paragraphs 3.3.5.1.12 for the physical interface to the FTI.

f. The NVS **must** comply with the mechanical interconnection requirements as specified in FAA-G-2100, paragraphs 3.3.5.4.1 for the physical interface to the FTI.

3.3.1.2 Wire/Cable

The cable lengths for the NVS to FTI interface will be specified during installation.

a. The NVS **must** utilize recognized media for cabling as specified in TIA/EIA-568-C, sub-clause 5.3 for the NVS to FTI interfaces.

b. The NVS **must** comply with the wiring requirements as specified in FAA-G-2100, paragraph 3.3.1.4.10 for the physical interface to the FTI.

3.3.1.2.1 Markings

a. The NVS **must** comply with the marking requirements as specified in FAA-G-2100, paragraphs 3.3.1.4.10.2 for the physical connection to the FTI.

b. The NVS **must** comply with the nameplates and marking requirements as specified in FAA-G-2100, paragraph 3.3.3 for the physical connection to the FTI.

3.3.1.3 Interface Wiring

a. The NVS **must** utilize pin/pair assignments for 8P8C (RJ-45) connectors as specified in TIA/EIA-568-C.1, Clause 6.2.1 for the NVS to FTI interface.

3.3.1.4 Electrical Power/Electronic Referencing (Grounding)

a. The NVS **must** comply with the ground potential requirements as specified in FAA-G-2100, paragraph 3.3.5.1.1 for physical connections to FTI.

b. The NVS **must** comply with the grounding and bonding requirements as specified in FAA-G-2100, paragraph 3.1.1.9 for physical connections to FTI.

3.3.1.5 Fasteners

a. The NVS **must** comply with the fastener hardware requirements as specified in FAA-G-2100, paragraph 3.3.1.4.3 for all fasteners utilized for the physical connection to FTI.

3.3.1.6 Electromagnetic Compatibility

a. The NVS **must** comply with the electromagnetic compatibility requirements as specified in FAA-G-2100, paragraph 3.3.2 for the physical connection to FTI.

4. QUALITY ASSURANCE PROVISIONS

Compliance with the requirements stated in this IRD are deemed met when all the requirements specified in a paragraph are verified by one or more of the methods outlined in the subsequent subparagraphs. The results of the verification activities shall be expressed as either pass or fail.

4.1 General.

Interface requirements imposed by section 3 of this IRD shall be verified by use of the verification methods specified in paragraph 4.4 and at the verification levels (phases) specified in paragraph 4.5. Verification methods and levels shall be applied in accordance with Table 4-1, Verification Requirements Traceability Matrix (VRTM).

4.2 Responsibility for verification.

The program manager for the less mature voice switch has the responsibility for the interface requirements verification. The program manager for the more mature voice switch will assist in the verification.

4.3 Special verification requirements.

This IRD imposes no special test equipment requirements.

4.4 Table 4-1, Verification Requirements Traceability Matrix.

Verification shall be in accordance with Table 4-1, Verification Requirements Traceability Matrix (VRTM).

Table 4-1. Verification Requirements Traceability Matrix

(Verification Methods: D - Demonstration, I - Inspection, A - Analysis, T - Test, X - Not Applicable)

Section	Requirement	Verification Phase and Method			
		Sub-system Level	Integration Level	Site Level	Remarks
3.1.1.a	The NVS must interface with the FTI to support Networked A/G communications.	D	D	D	
3.1.1.b	The NVS must interface with the FTI to support Networked G/G communications.	D	D	D	
3.1.1.c	The NVS must interface with the FTI to support NVSMS communications.	D	D	D	
3.2.3.5.a	The NVS must support Network layer interfaces to the FTI as specified in FAA-STD-039c, section 5.3.	D	D	X	
3.2.3.5.b	The NVS must support Network layer addressing as specified in FAA-STD-042b, section 5.3 for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.a	The NVS must support IPv4 protocol, as specified in RFC 791, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.b	The NVS must support Internet Control Message Protocol (ICMP), as specified in RFC 792, for the NVS to FTI interface.	D	D	X	

3.2.3.5.1.c	The NVS must support the capabilities specified in RFC-2474 for IPv4, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.d	The NVS must support the capabilities specified in RFC-3168 for IPv4, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.e	The NVS must support the capabilities specified in RFC-3260 for IPv4, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.1.a	The NVS must support addressing for IPv4 protocol, as specified in RFC 796, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.1.b	The NVS must support address allocation for IPv4 protocol, as specified in RFC 2050, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.1.c	The NVS must support address assignment for IPv4 protocol, as specified in RFC 1918 and the latest version of NAS1370-500.4., for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.1.d	The NVS must support address subnetting for IPv4 protocol, as specified in RFC 950, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.1.e	The NVS must support Classless Interdomain Routing for IPv4 protocol, as specified in RFC 1518 and RFC 1519, for the NVS to FTI interface.	D	D	X	
3.2.3.5.1.2.a	The NVS must support interior routing functionality for IPv4 protocol, as specified in FAA-STD-039c, section 5.3.2.1 for the NVS to FTI interface.	D	D	X	
3.2.3.5.3.a	The NVS must support Internet Group Management Protocol	D	D	X	

	(IGMP) as specified in RFC 3376 and RFC 4604 for the NVS to FTI interface.				
3.2.3.6.a	The NVS must support Ethernet implemented as the Data link layer as specified in FAA-STD-039c, section 5.2 for the NVS to FTI interface.	D	D	X	
3.2.3.6.1.a	The NVS must support transmission of IP datagrams over IEEE 802.3 networks as specified in RFC 1042 for the NVS to FTI interface.	D	D	X	
3.2.3.6.1.b	The NVS must support transmission of IPv4 datagrams over Ethernet networks as specified in RFC 894 for the NVS to FTI interface.	D	D	X	
3.2.3.6.1.c	The NVS must support transmission of IPv6 datagrams over Ethernet networks as specified in RFC 2464 for the NVS to FTI interface.	D	D	X	
3.2.3.6.2.a	The NVS must support the Ethernet interface logical link control sub-layer as specified in IEEE Std 802.2, 1998 Edition(R2003) Part 2: Logical Link Control for the NVS to FTI interface.	D	D	X	
3.2.3.6.3.a	The NVS must support Address Resolution Protocol as specified in RFC 826 for the NVS to FTI interface.	D	D	X	
3.2.3.7.a	The NVS must support Ethernet as a Physical layer interface as specified in FAA-STD-039c, section 5.1 for the NVS to FTI interface.	D	D	X	
3.2.3.7.b	The NVS must support implementation of 100BASE-	D	D	X	

	FX Ethernet over fiber as specified in FAA-STD-061.				
3.2.3.7.c	The NVS must support the Ethernet physical layer interface in accordance with IEEE 802.3-2008, Section 6 and Section 7 for the NVS to FTI interface.	D	D	X	
3.2.3.7.d	The NVS must support 100BASE-T media in the physical layer in accordance with IEEE 802.3-2008, Clause 22 Reconciliation Sublayer (RS) and Media Independent Interface (MII) and Clause 28 Physical Layer link signaling for Auto-Negotiation on twisted pair for the NVS to FTI interface.	D	D	X	
3.2.3.7.e	The NVS must support 100BASE-FX media in the physical layer in accordance with IEEE 802.3-2008, Clause 22 Reconciliation Sublayer (RS) and Media Independent Interface (MII) and Clause 26 Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX for the NVS to FTI interface.	D	D	X	
3.2.3.7.f	The NVS must support Gigabit media in the physical layer in accordance with IEEE 802.3-2008 Section 35 Reconciliation Sublayer (RS) and Gigabit Media Independent Interface (GMII) for the NVS to FTI interface.	D	D	X	
3.2.3.7.g	The NVS must support at least two physical media connections to the FTI edge device(s) to support high	D	D	X	

	availability network service requirements for the NVS to FTI interface.				
3.2.3.7.h	The NVS must support at least two IP connections to each A/G communication channel (each channel consists of up to two frequencies).	D	D	X	
3.3.1.1.a	The NVS must terminate category 5e cable with connecting hardware as specified in TIA/EIA-568-C.1, sub-clause 10.2.3 for the NVS to FTI interface.	I	I	X	
3.3.1.1.b	The NVS must terminate fiber cable with connecting hardware as specified in TIA/EIA-568-C.1, sub-clause 10.3.2 for the NVS to FTI interface.	I	I	X	
3.3.1.1.c	The NVS must comply with the removable parts and mating connector requirements as specified in FAA-G-2100, paragraphs 3.1.2.1 for the physical interface to the FTI.	I	I	X	
3.3.1.1.d	The NVS must comply with the electrical connector requirements as specified in FAA-G-2100, paragraphs 3.3.1.4.3 for the physical interface to the FTI.	I	I	X	
3.3.1.1.e	The NVS must comply with the electrical connector safety requirements as specified in FAA-G-2100, paragraphs 3.3.5.1.12 for the physical interface to the FTI.	I	I	X	
3.3.1.1.f	The NVS must comply with the mechanical interconnection requirements as specified in FAA-G-2100, paragraphs	I	I	X	

	3.3.5.4.1 for the physical interface to the FTI.				
3.3.1.2.a	The NVS must utilize recognized media for cabling as specified in TIA/EIA-568-C, sub-clause 5.3 for the NVS to FTI interfaces.	I	I	X	
3.3.1.2.b	The NVS must comply with the wiring requirements as specified in FAA-G-2100, paragraph 3.3.1.4.10 for the physical interface to the FTI.	I	I	X	
3.3.1.2.1.a	The NVS must comply with the marking requirements as specified in FAA-G-2100, paragraphs 3.3.1.4.10.2 for the physical connection to the FTI.	I	I	X	
3.3.1.2.1.b	The NVS must comply with the nameplates and marking requirements as specified in FAA-G-2100, paragraph 3.3.3 for the physical connection to the FTI.	I	I	X	
3.3.1.3.a	The NVS must utilize pin/pair assignments for 8P8C (RJ-45) connectors as specified in TIA/EIA-568-C.1, Clause 6.2.1 for the NVS to FTI interface.	I	I	X	
3.3.1.4.a	The NVS must comply with the ground potential requirements as specified in FAA-G-2100, paragraph 3.3.5.1.1 for physical connections to FTI.	I	I	X	
3.3.1.4.b	The NVS must comply with the grounding and bonding requirements as specified in FAA-G-2100, paragraph 3.1.1.9 for physical connections to FTI.	I	I		
3.3.1.5.a	The NVS must comply with	I	I		

	the fastener hardware requirements as specified in FAA-G-2100, paragraph 3.3.1.4.3 for all fasteners utilized for the physical connection to FTI.				
3.3.1.6.a	The NVS must comply with the electromagnetic compatibility requirements as specified in FAA-G-2100, paragraph 3.3.2 for the physical connection to FTI.	I	I		

4.5 Verification levels and methods.

The levels and methods of verification appropriate for use in the VRTM, presented in Section 4 of the IRD, are defined in the following paragraphs.

4.5.1 Verification levels.

a) Subsystem Level. This level of verification is usually accomplished at the contractor's facility and culminates in the formal acceptance of a contractual end-item.
b) Integration-level. This level of verification is conducted at the FAA William J. Hughs Technical Center (WJHTC), or at a key site. The verification conducted will determine if the hardware, software, or subsystem to be deployed for site installation will perform in a NAS environment and in accordance with NAS system-level operational and functional requirements.
c) Site-level. This level of verification is usually performed at the designated site. The verification portion of the subsystem installation and checkout will emphasize demonstration of the overall system performance requirements. It includes the demonstration of an end-item, subsystem and/or system, the final acceptance demonstrations, and commissioning activities.

4.5.2 Verification Methods.

There are four verification methods that can be used at any of the three verification levels. Verification methods are:

a) Inspection. Inspection is a method of verification to determine compliance without the use of special test equipment, procedures, or services, and consist of

a non-destructive static-state examination of the hardware, software, and/or the technical data and documentation.

b) <u>Test</u>. Test is a method of verification wherein performance is measured during or after the controlled application of functional and/or environmental stimuli. Quantitative measurements are analyzed to determine the degree of compliance to the success criteria stipulated in the IRD or project specification. The process uses standardized laboratory equipment, procedures, hardware, and/or services.

c) <u>Demonstration</u>. Demonstration is a method of verification where qualitative determination of properties is made for configuration items, including software, and/or technical data and documentation measured, in a dynamic state.

d) <u>Analysis</u>. This method of verification consists of comparing hardware or software design with known scientific and technical principles, procedures, and practices to estimate the capability of the proposed design to meet the mission and system requirements. When certain elements of design are comprised of previously qualified elements such as commercial off the shelf (COTS) equipment, then analysis of previous qualification testing in meeting specification requirements may be used to reduce the amount of qualification testing.

5. PREPARATION FOR DELIVERY

This section is not applicable to this IRD.

6. NOTES

6.1 <u>Definitions</u>.

Access Device: An Ops IP access device is defined as user system equipment that supports user connections to the FTI Operational IP network.

Circuit: A circuit is a point-to-point or multipoint telecommunications link between specific locations.

Edge Device: An IP edge device is defined as an FTI CPE element that supports user connections to the FTI Operational IP network.

FTI Service: An FTI service is an SDP-to-SDP telecommunication link provided by the service provider.

Ops IP Connection: An Ops IP connection is a circuit or local cable providing a communications path for the flow of IP packets (over Data Link and Physical mechanisms and protocols) between a user access device and an FTI edge device.

Ops IP Service: Ops IP services are connection-less (sometimes referred to as Point-to-Cloud) services. They have a single SDP that provides connectivity to the NAS Ops IP network. For Ops IP services the service is not end-to-end but extends from the user system to the Ops IP network.

NAS System-to- System Ops IP Service: While Ops IP services are defined, ordered and implemented as individual Point-to-Cloud services, logical NAS end-to-end data flows allow two NAS systems to communicate.

Voice Grade (VG): A term used to describe the per-formance characteristics of a channel, line, facility, or service that is suitable for the transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3000 Hz.

Zero Transmission Level Point (0,0 TLP): Indicates that there are two reference points on a line between which there will be no overall change in signal power. Establishes unity gain (no loss or gain) between these points of reference.

6.2 <u>Abbreviations and acronyms.</u>

A/G	Air to Ground
BGP	Border Gateway Protocol
COS	Class of Service
CPE	Customer Premises Equipment
FAA	Federal Aviation Administration
FDDI	Fiber Distributed Data Interface
FTI	FAA Telecommunications Infrastructure
FTSD	FTI Telecommunications Services Description
G/G	Ground to Ground
ICMP	Internet Control Message Protocol
IP	Internet Protocol

IRD	Interface requirements documents
ISO	International Standards Organization
LLC	Logical Link Control
MAC	Media Access Control
Mbps	Megabits Per Second
NAS	National Airspace System
NVSMS	NVS Management System
OSI	Open System Interconnection
PDU	Protocol Data Unit
RFC	Request for Comments
RMA	Reliability/Maintainability/ Availability
SDP	Service Delivery Point
TBD	To Be Determined
TCP	Transmission Control Protocol
UTP	Unshielded Twisted Pair
VG	Voice Grade
VRTM	Verification Requirements Traceability Matrix
WC	Work Center